APBA

OPC INSPECTION MANUAL

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Section I

INTRODUCTION

The inspector has two important functions:

1. **To insure a maximum of safety to the driver, through the use of properly designed and built racing equipment;**

2. **To insure all drivers of fair competition.**

The first of these functions is achieved by the pre-race safety inspection. In conducting the pre-race safety inspection it is well to remember that as boat designs and construction change, always be alert to new safety problems not covered in these pages.

When a safety problem is uncovered, the driver is to be notified as promptly as possible in order to provide him with every opportunity to correct his problem before the race. Under no circumstances should he be allowed to go out for testing or racing if the problem is reasonably likely to result in unnecessary danger to the driver, his competitors, or bystanders.

The final responsibility for safety at a race rests with the referee. Therefore, if the inspector should be unable to secure voluntary compliance with his instructions, the referee must be immediately notified by the inspector. From that point onward, the full responsibility for actions relative to the uncovered safety problem rest with the referee.

The second function of the inspector, assurance of fairness of competition to all drivers, is achieved within varying practical limits by the post-race technical inspection of the winning equipment. In this activity, it is the inspector's goal to determine if the winners have achieved their success over their fellow competitors without resorting to illegal modifications of their equipment.

It is well to remember that the inspector is in no position to determine if a given illegal modification is of potential racing advantage to the driver; the only question before the inspector is whether a rule has been violated. The reason for this policy is that there are many illegal modifications which are dependent upon racing conditions, boat design, or engine design which may or may not constitute an advantage – and even an expert designer could not decide on the merits of the case without exhaustive tests. Obviously the inspector is in no position to run such tests during his post-race inspection.

Thus, the inspector only decides whether the equipment meets all the requirements of the rules. If it does not, the referee is to be notified; it is the referee's duty, if in agreement with the inspector, to disqualify the driver. Irrespective of the source of the illegality, it is the driver's responsibility if a technical violation comes to light.

To aid the inspector in his check for technical violation a number of tools are required. These tools can be classified as primary and secondary tools.

- **The primary tools, a typical selection are measuring devices which allow the determinations of exact dimensions. (listed in Section 4)**
- **The secondary tools are time savers for the inspector and are used by the inspector for rapid screening. (listed in Section 5)**
- **When a part is found to be potentially illegal, through the use of a secondary tool, it must be inspected with a primary tool before a decision can be rendered.**

In conclusion, it must be reiterated that the inspector's goal is to do his best towards a safe and fair race; avoiding action on a safety problem may result in unnecessary injury or death, avoiding action on a technical infraction may help one driver while at the same time cause an injustice to all the other drivers in his heat of racing.

Section 2

Driver____Boat #__________________

Class_______________Date_______________Location_______________________

2008 OPC Safety Checklist

[ ] Cockpit Training renewal date imprinted on membership card. If no date on card must show receipt of Capsule Training completion (within acceptable dates).

[ ] Helmet:
- [ ] See page SR-1 3 (A)
- [ ] Upper 50% must be orange or yellow [open and unrestrained cockpits]
- [ ] Check condition

[ ] Jacket:
- [ ] Label that indicates type of category; A, A-100, B or C.
- [ ] Upper 50% must be orange or yellow
- [ ] Check condition

[ ] Engine stop: (Non-reinforced cockpit)
- [ ] Safety Lanyard

[ ] Lifting sling: minimum ¼" steel cable or 1" nylon strap, snap hooks or clevis pin
- [ ] Check condition

[ ] Driver Restraint boats: 12" numbers on bottom under driver seat, orange not required. Black numbers on white background or strong contrasting colors are acceptable.

[ ] Air Vents: 3 square inches per picklefork or 6 square inches on "V" nose boat

[ ] Sponson tips: collapsible, removable. Sponson ends must have a spherical radius.

[ ] Boat Numbers: Per Rule 19

[ ] Gas tank, Battery/batteries, and all accessories securely bolted or tied.

[ ] Engine properly bolted

[ ] Check Swivel Pin and Trim Ram for free play and trail-out

[ ] Check power trim and up & down for proper function

[ ] Steering: check all hardware & fasteners, check full travel

[ ] **Throttle pedal: check return for proper operation**

[ ] **Ballast: must be securely fastened**

[ ] **Flotation foam: proper volume**

[ ] **Check general condition of the hull**

[ ] **Reinforced Cockpits:**

- [ ] **Manufacturer's name**
- [ ] **Date of Manufacture**
- [ ] **Reinforced cockpits built after January 1, 2005 must have Identification Label with at the manufacturer's name, Newton Test rating and the build date.**
- [ ] **Padding inside**
- [ ] **Clearance of Head**
- [ ] **Quick Release steering wheel**
- [ ] **Five-Point Harness in compliance with current APBA OPC Rule Book**
- [ ] **Check engine shutoff and fuel shutoff switches mounted outside left upper rear of capsule**
- [ ] **Check inversion switches**
- [ ] **Positive Air-Flow Ventilation and removable hinge pins with pull rings**
- [ ] **½ ' Ethofoam behind helmet**
- [ ] **Internal and External canopy release**

Driver's Signature____

I have read and understand the APBA General Safety Rules and the APBA OPC Safety Rules

Section 3

DETAILED PRE-RACE INSPECTION PROCEDURE

1. First of all, let us take the construction of the boat. Check the application of the deck to the hull, whether it be fiberglass or wood. On glass models make sure the deck is glassed or fastened to the hull; on wood models make sure that it is either bolted, screwed or nailed sufficiently so it won't come off. Check both boats for cracks, open seams, busted battens and stringers. Make sure that the transom itself is sufficiently bolted or glassed to the rest of the boat, and on boats with cowls that cover the gas tank and fuel compartment make sure that the fasteners are bolted on and that the cowl itself is bolted or secured to the boat so that it cannot jar loose and come off while the boat is underway.

2. Application of engine to boat. Make sure that the engine itself is clamped on with the clamp bracket securely and that the engine is also bolted on.

3. Steering wheels. Check the steering wheel itself. See that it is bolted to the dashboard or if it's a breakaway model that it is bolted to the floor of the boat. Check the wheel to see if there are any cracks. Check how much tension you have on the steering cables themselves. Check the pulleys. Make sure that the pulleys are not worn and that the center of the pulley itself is not rounded out or too loose. Check the steering cables. Look to see if a cable is frayed or one of the strands is broken. This would indicate that there is a weak spot in the cable or there had been a tremendous amount of pressure at that point. What you would do in this case is have the competitor replace the cable. Reason: the broken strand is an indication of a weakened condition of the cable and it might snap the rest of the way through. Check the swivels to make sure they are not worn and that they are fastened securely. Check the fasteners on the boats themselves.
Make sure they are bolted on and safety wired where necessary. Check the steering bar. Make sure the steering bar is not cracked and make sure that the steering bar is bolted to the engine so they cannot wiggle it back and forth or up and down.

4. Gas Tank. Check the gas tank for leaks. Check to make sure that the cap on the gas tank is on tight. Make sure that the gas tank is fastened down to the boat so it cannot wobble around and fly out.

5. Check the fuel line. Make sure that the fuel lines are not weathered or cracked. Make sure that they are not laying next to any electrical cables so that if gas did happen to spill you might have a fire. Check the fittings at the engine and tank ends and make sure that they are tightly on and there are no leaks there.

6. The battery. <u>Check the battery</u> to see if it has any cracks. A cracked battery will let acid run out into the bottom of the boat and might eat through some of the electrical cables and cause a fire. A spark and battery acid may cause an explosion. Make sure that the filler caps are on. If the battery is tied with a rope make sure that the acid has not eaten through the rope consequently letting the battery fly loose. If the rope looks bad or worn have the competitor replace it.

7. We have a rule in the rule book about <u>floatation</u> which is really unenforceable, because we are not about to take somebody's boat out there and sink it to see if it has enough floatation in it to keep it up. What you might want to mention to the competitor for his own personal reasons is that if the boat did sink out there and he is down in 80 or 90 feet of water he may take a chance on not getting that boat back so you might want to warn him about putting some floatation in it, either man-made or natural.

8. <u>Kill switch</u>. Refer to the Safety Rules which tell you that the kill switch has to be basically a positive disconnect into the electrical system itself so that when a competitor leaves the boat that he will permanently disconnect the ignition system and kill the engine so it cannot run away from him. Also that the kill switch lead cannot be any longer than 4 feet and a minimum of 30 pounds pull before the tether could break.

9. Check for <u>foreign objects</u> in the cockpit area. We do not want old shoes lying in there and pieces of equipment that are not really necessary to a race boat which you will find from time to time lying inside the cockpit of a boat. You will find drivers come with their equipment in their boats because of lack of room in their cars…extra gas tanks, batteries, spare tires, tools, etc. That is frequently how they come to race inspection. Make them show you the boats as they will run it, because sometimes they forget to take out all the unnecessary equipment.

10. <u>Bolts protruding beyond reason</u>. You will find sometimes that people who use bolts to bolt on their hardware tend to leave an excessive amount of bolt sticking inside the cockpit which could very easily be sawed off with a hacksaw and thus prevent ripping an arm open if he should fly out of his boat.

11. <u>Return spring and throttles</u> – hand and foot. Make sure that the return spring works sufficiently enough to pull the throttle back to an idle position, and make sure that these return springs and whatever apparatus they use, are not in the way of the kill switch tether.

12. <u>Shift control lever</u>. Keep that away from the kill switch tether also. We do not want to get this man tangled up. That is the reason for that 30 pound test on the line. If a man did happen to get tied up inside a boat and he could not get out he would have enough strength to break the line and get free.

13. Check and make sure the <u>seat is bolted down</u>.

14. Make sure all <u>ballast is bolted or glassed or fastened</u> in.

15. Motor mounts. Check the motor mounts to see if they are worn or loose. Too loose motor mounts and the powerhead will wiggle back and forth and bounce around and cause inaccurate steering and dangerously poor boat handling.

16. The shift throttle and electrical cables. Make sure that they are out of the way, that they are tucked down somewhere where the competitor cannot get his feet tangled up in them if he gets thrown out of the boat.

17. Check the clothing and give them the once-over now. This is kind of hard to enforce, but you might want to warn them of long shoelaces, etc. You might want to tell them it is a good idea to have the cuffs on his shirt or suit or whatever he is wearing kind of snug around the wrist and around the ankles.

18. You are looking at a power trim. Check the hydraulic lines for breaks, fittings for leaks and the switch on the steering wheel. Make sure it is not corroded from a previous flip and that it operates up and down without any difficulty.

19. Check the life jacket. This is very important. This is the only means to keep an injured man floating. Check for old or worn jackets and battery acid holes.

20. Check the helmet. Make sure the helmet is not cracked. No holes in the helmet. Check the chin straps and make sure they are not torn. Check the general shape of the helmet itself. Check for old and weak shells and liners.

Section 4

REPRESENTATIVE LIST OF PRIMARY INSPECTION TOOLS

1. 0 – 1" Micrometer
2. 1 – 2" Micrometer
3. 2 – 3" Micrometer
4. 3 – 4" Micrometer
5. Vernier or Dial Caliper and Depth Gage Combination 0 – 6" Standard Size
6. 50 cc Burette or Syringe, 1 cc Accuracy
7. 1' Increment Protractor or Degree Wheel
8. 0 – 3" Dial Indicator (optional)
9. 2 – 4" Inside Micrometer (optional)
10. 0 – 5" Depth Micrometer (optional)
11. Go-No-go Gages (Number Drills)

Section 5

THE USE OF SECONDARY MEASURING TOOLS

The classical measuring tools, such as micrometers, verniers, and the like…tools we call primary tools… are plenty accurate for inspection purposes, but in many instances they are just too cumbersome or too slow to permit a good quick inspection. To cover some of these situations the following is a discussion of a few secondary tools.

It can be said that when we inspect an outboard motor, we are not machinists and don't really care how big or how small a part or a dimension might be. As long as it is within the size limits that the manufacturer says it is, an inspector should be satisfied. Of course size is not the only thing an inspector must consider, but measuring tools are what we are going to discuss in this portion of the program.

Let us define a couple of terms, then. Let us call tools that measure the exact size of something Primary Tools and we will call tools that gage something to be the same size as themselves, Secondary Tools.

We all know what Primary tools are; micrometers and the like. Secondary tools, though, are more nondescript and take on literally any shape or form imaginable.

The principle of these tools is best described by an example. A typical secondary tool is the round plug gage. This gage is used to gage whether a round hole is within a certain set of limits. A plug gage to verify these limits can be made from a piece of round bar stock say, six inches long. One end of the stock is turned to the minimum specified limit and the other end of the stock turned to the maximum specified limit. When we place our gage into the hole, we will know immediately if the hole is oversized, undersized, or with tolerance limits. If we try to insert our gage into the hole in question and find that neither end will fit, the hole is too small. If we find that both fit into the hole, the hole is too big. If, however, we find that the small end fits into the hole, but the large end will not, the hole is in tolerance. That is to say that it is larger than the minimum limit, but smaller than the maximum limit. All this time we spent gauging this hole we never found out how big it really was, but we really didn't care, as long as it was as big as it was supposed to be. Go-no-go measurements, as these are called, are usually faster, easier and as dependable as those performed with primary tools.

This type of measurement is eminently suited to motor inspection in so far as it is fast, easy, accurate, and the gages used are not as subject to damage in the field as primary tools.

While not all dimensions on a motor can be checked for proper size using secondary tools, there are some that are very difficult to gage without using them totally or in conjunction with primary tools.

Items such as lower unit skegs, for example, cannot be measured easily with a scale and calipers, but a simple template cut from a sheet of 1/8 inch hard drawn aluminum can easily be

made in the silhouette of a skeg and then fit to the lower unit in question thus showing if the skeg has been tampered with.

The intake port height of OMC three cylinder motors is not externally accessible, thus it must be measured from inside the cylinder. I know of no primary tool that can fit into the cylinder to measure this, but a secondary tool can be made without too much difficulty from two pieces of small diameter steel tubing. Select pieces about eight inches long, with diameters that will allow them to telescope. Make the small diameter piece about three inches shorter than the larger diameter one. On the large piece, silver solder a small piece of steel to form an "L" shape. Do the same on the other piece of tubing. Now, the small piece of tubing is fitted inside the large one, and the soldered-on legs are aligned.

It can be seen that as we move the inside and outside portions of our telescope we can put the legs against the inside walls of any opening from about ¼ inch to about an inch and ½. If we put a setscrew in the outer portion, it can be locked to hold our measurement so that we can pick it off with a micrometer.

Measuring the gear ratio of a motor can be a very time consuming affair unless we can come up with a simple tool to do the job more efficiently. Just the thing can be made from the degree wheel that every inspector has in his little black bag. Install the degree wheel on to the prop shaft. Put the flywheel at TDC (top dead center) and the TDC position of the degree wheel in the straight-up position with a pointer. Now turn the flywheel one complete revolution and read the number now in the straight-up position on the degree wheel. The number of degrees, of course, has already been calculated and written into your spec sheet on some past rainy night by yourself, so it is no problem to look there and compare your number to the number appearing on the degree wheel.

If, by chance, you have not ever done this type of calculation, we can go through one now.

14:23 gear ratio

With this ratio, the flywheel turns 23 times for each 14 times for the propeller. 14:23 can be written as $\frac{14}{23}$

If you divide 14 by 23 you get 0.61 0.61 is 61% of a full revolution. If you multiply 0.61 by 360, the number of degrees on a circle, you get 220, the number of degrees that the prop shaft turned. On the spec sheet, in the same box as the gear ratio, write 220 and you are all set to measure gear rations. If you don't mind marking up your degree wheel, you can simply scribe 14:23 at the 220 degree position on it, as well as the model of the engine it corresponds to, thus eliminating looking it up in your spec sheet all the time.

The problem of cylinder bore measurement has, in the past been rather difficult, especially in those engines without conventional cylinder heads. Some time ago, the "S" shaped bore measuring device was developed; this was a great improvement in taking the cylinder block off of the crank case to measure the bore with an inside micrometer.

This tool, although I call it a secondary tool, is not really one in the true sense of the word, because it must be used in conjunction with a primary tool. The same is true for many other of this type of tool, but the fact remains that by using secondary tools, we can work quickly, accurately, and easily no matter what they are called.

There is a whole family of gages similar to the one I first mentioned…the go-no-go type. If these are made to the maximum limit of the part they can be used to quickly determine items like port size, carb venturi diameter, and cylinder bore of engines whose heads are removed or whose cylinders are separated from their crankcases. All that is necessary with these gages is that they be made at the largest possible limit of the item being measured so that they will not fit into it if the item is of specific size. Your imagination and ability are the only things you need to have to come up with a whole pile of gages that can allow you to inspect most any motor with a minimum of time.

Secondary tools are about the most useful things an inspector can have but we must remember that if it comes down to the nitty-gritty and there is some reason that exact numbers must be known, they are simply not enough. As handy as they are, secondary gages simply cannot give up precise numbers. There is simply no way that they can say that an engine has a bore of 2.875 inches, 28 cc's, .625 inch high ports, or anything else that has a number on it. For this reason there are times when only primary gages can be used. Record courses, Nationals, Divisionals, Regionals and the like, all demand that the inspector insure that the inspector satisfy all as to their legality. The only way this can be done is to measure the engine components with primary tools so that there can be no question as to their legality.

Therefore, we can see that there is a place for both types of measurement systems. The race circumstances and the discretion of the inspector should be the factors that determine whether the exact size of a part or the simple fact that it is within tolerance are desired in any given circumstance.

Section 6

RECOMMENDED PROCEDURE FOR MEASURING COMBUSTION CHAMBER VOLUME

1. **The engine should be elevated in such a manner so that the face of the cylinder head is horizontal in position.**

2. **The piston in the cylinder to be measured should be set at top dead center [t.d.c.]**

3. **A titrating burret (glass or plastic) of the proper size graduated in 0.1 c.c. increments should be used.**

4. **The tip of the burret will have to be enlarged to permit the fluid to flow fast enough so that leakage around the ring gaps does not give an erroneous reading. The hole size should be between .075 and .090.**

5. **Use Marval Mystery Oil as the measuring fluid.**

6. **The burret should be filled with the measuring fluid to well above the 0.00 c.c. mark.**

7. **The liquid in the burret should be inspected to insure that there are no bubbles present especially at the location of the meniscus. Air bubbles will afford an erroneous reading. Tapping the side of the burret gently will dissipate bubbles.**

8. **The burret should be drained through the use of the stop-cock so as to read 0.00 exactly.**

9. **The burret should be read at the bottom of the meniscus [the concave line at the top of the fluid level] and only at the bottom!**

10. **The burret should then be drained into the cylinder containing the piston placed at top dead center until the fluid reaches the very top of the spark plug threads.**

11. **Care should be taken so as to drain the burret slowly enough in order to insure that there are no bubbles inside the cylinder head.**

12. **Wait at least two minutes for the fluid to run down the sides of the burret, then proceed to Step 13.**

13. **The titrating burret should be read at the bottom of the miniscus for the measurement. The reading should be taken to the nearest one-hundredth [0.01] of a c.c. In order to do this with a burret graduated in tenths of a c.c., it will be necessary to estimate the reading between the tenth [0.1] marks.**

14. **Any cylinders under the legal limit should be measured by taking off the head, drying the cylinder and head, using caution not to remove carbon build up, replacing the original head gasket and retorquing the head bolts to original specifications. If the head gasket is destroyed in removal, a new OEM head gasket of the same thickness is to be used.**
    Ziggy Boettle...3/1/1996   Jeff Titus...revised 10/26/2001

Section 7

FUEL TESTING GUIDELINES

It is recommended that evaluation of fuels be conducted using the following test, in the preference as listed.
Additional tests may be used if deemed necessary.

1. **Digatron DT - 15 Fuel Meter Test or**
   DT - 47FT Fuel Meter Test (for instructions see owner's manual)
   GT – 100 Fuel Meter Test

2. **Specific Gravity Test**

3. **Water Solubility Test**

4. **Ceric Nitrate Reagent Test**

Instructions for each of the above four tests are stated on the following pages.

DIGATRON DT-15 FUEL METER TESTING INSTRUCTIONS

The purpose of this test is to measure certain electrical properties of the fuel sample and determine if they are within the permissible limits.

The test procedures described here within are in accordance with the instructions supplied by the Digatron DT-15 fuel meter manufacturer.

Before performing your fuel testing, ensure that the fuel meter is in good working order.

- **Sensor Condition - Visually check the sensor and its connecting wire to assure that it has not been physically damaged.**

- **Battery Condition - When the meter is on, the words "LO BAT" will appear in the upper left corner of the display if the battery needs to be replaced. DO NOT utilize the meter if the "LO BAT" is displayed, as its readings will not be accurate.**

The recommended fuel test procedure is as follows:

1. **Turn the meter on and allow it to warm up at least 15 minutes before doing any**

testing. This will allow the internal components to stabilize at their normal operating temperature.

2. **Attach the sensor's connecting wire to the meter. Hold the sensor's connecting wire and lower the sensor into the calibration liquid - Cyclohexane (C6H12) - such that the sensor is completely submerged. Take care to assure that the sensor is not in contact with the fuel container. Gently wiggle the sensor wire to displace any air bubbles which may be trapped between the sensor plates. Using the knob on the front of the meter, adjust until "-75" is shown on the display.**

3. **Remove the sensor from the calibration liquid, and blow any excess liquid from between the sensor plates. Lower the sensor into the fuel sample, in the fashion described in item #2 above. Observe the reading on the meter's display. If the reading is zero or a negative number, the fuel is legal. If the reading is greater than zero (a positive number), the fuel is not legal.**

The electrical characteristics of gasoline change somewhat with temperature. As such, it is important that the temperature of the calibration liquid and the fuel sample be within about 15' F of each other.

When a fuel sample is found to be illegal, per the above procedure, it is recommended that the following additional steps be performed:

- **Clean the sensor with some spray-on brake cleaner and allow it to air dry at least 30 seconds.**
- **Recheck the calibration setting (-75) of the meter in cyclohexane, and adjust if necessary.**
- **Allow the fuel sample to stabilize to the same temperature as the Cyclohexane, then repeat the test as described in item #3 above.**

During the course of the day, it is recommended that the calibration setting in cyclohexane be occasionally checked. It is interesting to note that the calibration reading of "-75" in cyclohexane has a corresponding reading when the sensor is in air. Although this corresponding air reading varies somewhat between individual meters, it tends to be quite consistent for each particular meter. As such, the specific corresponding air reading, for the particular meter being used, can be a useful reference during the time between occasional cyclohexane calibration checks.

There is another way, however to use the Digatron meter. If we take a fuel sample and add a roughly equal amount of water to it then agitate it we should get two clearly separated layers of liquid in the container. <u>Fuel on the top and Water on the bottom.</u> Then take a reading with the digatron meter on the fuel portion of the fuel/water sample and a reading on a fuel-only sample from the tank. If nothing has migrated from the fuel to the water, the meter readings should be exactly the same. However, if the fuel contains anything that leaves the fuel to

dissolve in the water instead, the reading of that fuel will be different than the fuel that was not exposed to it. It is probably a good idea to allow 5 points of leeway on the reading, plus or minus, to allow for any minor absorption of elements in the oil, but anything more than that is an excellent indication that something is in the fuel that should not be there. This test will not be able to tell you who put whatever in there, but it is a reliable test for most of the commonly used illegal additives.

SPECIFIC GRAVITY TESTING INSTRUCTIONS

The purpose of this test is to measure the relative density of a fuel sample and determine if it is within the permissible limits.

Two pieces of special equipment are required to perform this test:

1. **Specific gravity hydrometer(s) which cover the range of 0.750' – 0.800 (at 60' F)**

2. **A clear glass container which is at least as tall as the hydrometer. A "graduated cylinder" works well for this purpose.**

The recommended fuel testing procedure is as indicated below:

- **Assure that the glass container and hydrometer are clean.**

- **Place the glass container on an essentially level surface and fill with the fuel which is to be tested. The depth of fuel should be equal to, or greater than, the length of the hydrometer.**

- **Carefully insert the hydrometer into the fuel sample with the weighted end facing down. Take care to minimize the contact between the hydrometer and the container.**

- **When the hydrometer has reached a stable free float in the fuel sample, read the specific gravity from the scale within the hydrometer. This is done by visually sighting along the upper surface of the fuel and reading where the scale crosses the fuel's surface. Record this reading.**

- **Measure the temperature ('F) of the fuel.**

- **The specific gravity characteristics of fuel (gasoline and oil) change somewhat with temperature. As such, the maximum permissible specific gravity reading will change as the fuel temperature changes.**

- **Below is a listing of the maximum permissible specific gravity readings and their corresponding fuel temperatures**

Fuel Temperature	Maximum Permissible Specific Gravity Reading
40' F	0.785
50' F	0.780
60' F	0.775
70' F	0.771
80' F	0.766
90' F	0.761
100' F	0.757
110' F	0.752

WATER SOLUBILITY TESTING INSTRUCTIONS

The purpose of this test is to determine if water soluble additives are present in the fuel sample.

The only piece of special equipment necessary to perform this test is a graduated container. It is recommended that a good quality clear glass graduated cylinder be utilized, with a capacity of 100mL and subdivisions of 1.0mL (or less).

The recommended fuel testing procedure is as indicated below:

a. **Assure that the graduated cylinder is clean**

b. **Place the graduated cylinder on an essentially level surface.**

c. **Pour approximately 60mL of the fuel sample into the graduated cylinder.**

d. **Carefully measure and record the amount of fuel in the graduated cylinder using the scale on the cylinder.**

e. **Slowly pour approximately 35mL of water into the graduated cylinder.**

f. **The liquid in the cylinder will separate into two layers. The water will settle to the**

bottom of the cylinder, carrying water soluble additives with it. Often a froth will form in the lower layer. As such, allow some time for the froth to clear.

g. **Carefully measure and record the total amount of liquid in the graduated cylinder using the scale on the cylinder.**

h. **Subtract the amount of fuel in the cylinder (item d) from the total liquid (item g) to determine the exact amount of water which was added. Record this result.**

i. **Carefully measure and record the amount of liquid in the lower layer of the graduated cylinder using the scale on the cylinder.**

j. **If the amount of liquid in the lower layer (item i) is greater than the amount of water added (item h), the fuel contained water soluble additives and it not legal.**

CERIC NITRATE REAGENT TESTING INSTRUCTIONS

The purpose of this test is to determine if alcohol is present in a fuel sample.

Following is a list of the special equipment necessary to perform this test:

- **50mL graduated cylinder with subdivisions of 1.0mL (or less)**
- **100mL glass beaker**
- **18 mm X 150 mm clear glass test tube**
- **2 ounce glass dropper bottle with dropper assembly**

Following is a list of chemicals necessary to perform this test:

- **Ceric Ammonium Nitrate (NH4)2 Ce (NO3)6**
- **Nitric Acid (HNO3), (70%)**

The Reagent Solution should be made prior to the race (within a couple of days) and is done as follows:

1. **Pour 41mL of distilled water into the glass beaker**

2. **Carefully add 9.0mL if nitric acid to the water in the glass beaker.**

3. **Add 20 grams of Ceric Ammonium Nitrate to the solution in the glass beaker.**

4. **Dissolve the Ceric Ammonium Nitrate by gentle stirring. Slight heating of the solution will speed the process; however, <u>do not boil.</u>**

5. **Pour the Reagent Solution into the dropper bottle and secure the cap. The Reagent Solution should have a yellow color.**

The recommended fuel testing procedure is as indicated below:

1. **Pour approximately 10mL of the fuel sample into the test tube.**

2. **Carefully add six (6) drops of the Reagent Solution to the fuel sample in the test tube.**

3. **Seal the open end of the test tube and invert several times.**

4. **The Reagent solution should accumulate at the bottom of the test tube. Observe the color of the accumulated Reagent solution. If it is the same color (yellow) as the original solution in the dropper bottle, the fuel sample contains no alcohol. If the accumulated Reagent solution in the test tube has changed from its original color (yellow) to orange or red, the fuel sample contained alcohol and <u>is not legal.</u>**

<u>GT – 100 FUEL METER TESTING INSTRUCTIONS</u>

The purpose of this test is to measure certain electrical properties of the fuel sample, and determine if they are within the permissible limits.

The test procedures described here are in accordance with the instructions supplied by the GT – 100 meter manufacturer.

Before performing your fuel testing, ensure that the meter is in good working order:

- **Probe condition – visually check the end of the probe to assure that it has has not been physically damaged. The outside tube should be essentially round in shape and should not be in contact with the center terminal.**

- **Battery condition – this is checked by grounding the center terminal of the** probe to the outside tube using a good electrical conductor. When grounded in this manner, the meter should read between 95 and 105. If the meter reads low, the battery should be replaced.

The recommended fuel test procedure is as indicated below:

1. Grasp the meter by the handle, with the meter in an essentially vertical position, with the probe facing down. Position your thumb over the red button.

2. Insert approximately one inch of the probe into the fuel sample (until the vent hole on the probe is covered). Take care to keep the probe off of the bottom of the fuel container, as water may have settled there and give an erroneous reading.

3. Press the red button and hold in. Observe the reading on the meter. Release the red button and remove the probe from the fuel sample.

4. Rinse the probe out in clean gasoline if you have been checking fuel samples with strong additives. This helps to purge the old fuel (preventing contamination between samples). Gently shake the unit once to make sure that no fuel is trapped inside the probe.

The electrical characteristics of gasoline change somewhat with temperature. As such, the maximum permissible meter reading will change as the fuel temperature changes. Below is a listing of the maximum permissible GT-100 meter readings and their corresponding fuel temperatures:

Fuel Temperature	Maximum Permissible GT-100 Meter Readings
50' F	36
60' F	43
70' F	50
80' F	57
90' F	64
100' F	70